PATENT ABSTRACTS OF JAPAN

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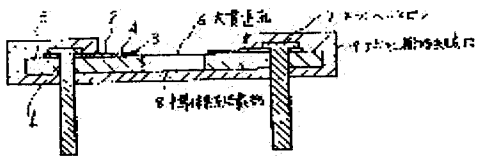
(54) WIRING BOARD FOR LOADING SEMICONDUCTOR ELEMENT



(57)Abstract:

PURPOSE: To obtain a wiring board, in which no warpage is generated and which has excellent mechanical strength and superior bonding properties and airtightness at the time of hermetic seal, by forming a large through-hole shaped at approximately the central section of a substrate, a wire bonding section formed to the periphery and a conducting circuit shaped brought into contact with the wire bonding section and the like.

CONSTITUTION: A wiring board for loading a semiconductor element consists of a large through-hole 6 formed at approximately the central section of a substrate, wire bonding sections 3, 4 shaped on the surface of the substrate dn the periphery of the large through-hole, a conducting circuit 2 formed brought into contact with the wire bonding sections so as to be conducted with the wire bonding sections, small through-holes 1 shaped, penetrating the conducting circuit and the substrate, and pins 7 inserted and fixed into the small through- holes, and other sections are coated with a synthetic resin, leaving the noses of at least the pins and the wire bonding sections. An article acquired by impregnating paper, a woven fabric consisting of glass fiber, a nonwoven fabric, etc., with a resin composition such as epoxy, phenol, polyimide, etc., and laminate- molding and curing it is used as a blank for the substrate.

[What is claimed is]

1. A wiring board for loading semiconductor element comprising;

a big through hole formed in the center of a substrate,

a wire bonding part formed on the surface of the substrate around the big through hole,

a conductive circuit formed in contact with the wire bonding part to conduct,

a small through hole formed through the conductive circuit and the substrate,

a pin which is inserted and fixed in the small through hole,

wherein at least the edge of the pin and wire bonding part are left, and others are covered with synthetic resin.

[Detailed explanation of the invention]

This invention is related to a wiring board for loading semiconductor element.

[Prior art and the problem]

So far, the method carried through the chip career made of the ceramics or the package made of the ceramics was general to carry a semiconductor element on the printed circuit board. But, permittivity of high alumina quality ceramics (The following ceramics is taken.) generally being used was high with about 9, and therefore it was not desirable material as for the super-speed-up of the operation speed in recent years because signal delay was big.

The collapse of the signal wave form by the stray capacitance of wiring was compared with the ceramics of the thing which it is rare in with about 5 more than ceramics, and heat-resistance was poor, and had the fault that thermal conductivity was low, and on the other hand, there was a limit in high dielectric constant of mounting by the glass epoxy wiring board.

Though it tries how to carry a silicon chip on the printed circuit board directly, on the other hand, the thing that a chip career was minded is most, and the thing which the number of terminals of input and output is large in becomes a pin grid array pattern package, and a fault to originate in the above ceramics isn't avoided.

When it stands a pin on the package made of the ceramics in the abbreviation vertical again, it is general to connect the pin which processed one end part into the head-shaped of the nail on metallization side with brazing filler metal. But, union strength is weak, and a problem takes place in the airtightness by the union of only brazing filler metal.

The union strength of the pin isn't unified in this method though a small penetration hole is set up in JP60-73760A as the way of dissolving the above problem in glass epoxy circuit board and one end part is processed into the head-shaped of the nail in the small penetration hole and the pin which formed a convexity in the middle is inserted and it tries the way of tightening that it engages in the convex part which it connects with, too.

As for this, it engages due to the dispersion of the diameter in the small penetration hole because strength isn't unified to form a conductor layer in the small penetration hole by the plating technology and to make the convexity formed in this conductor layer in the middle of the above pin engage.

As for keeping it, it is very difficult technology the union strength more than

it is always fixed.
A wiring board is sometimes transformed a little, and for example the curve of about 50 μm can happen per 10mm to bend a glass epoxy wiring board again and to use organic material such as the glass epoxy compound material part whose elasticity rate is low for the circuit board.
The fault that a rupture occurs in the solder union part by the cup of 2 - 3 μm arises in the thing which made a semiconductor element connect with distribution wiring board, mother chip and so on in the method which made a semiconductor element connect on the surface of the wiring board with a solder pillar again. This invention provides a wiring board for semiconductor element loading with these no faults.
[Method for solving the problem]
When a small penetration hole as follows semiconductor element circuit board carry part continuity circuit wire bonding part pin insert fixed was formed and these inventors formed a big penetration hole in the part which the semiconductor element of the circuit board was carried on more and left the tip of the pin and wire bonding part at least and the structure that other parts were covered with synthetic resin was taken, heat-resistance was possible for the thing as well whose it was high in comparison with glass epoxy wiring board, and permittivity was confirmed with about 5 as a result examined about the above fault the structure of the wiring board for air tightness sealing, and it was possible that a semiconductor element loading part inside the big penetration hole was made cavity structure and confirmed that it was suitable for semiconductor element mounting.
This invention is related to the wiring board for loading semiconductor element comprising;
a big through hole formed in the center of a substrate,
a wire bonding part formed on the surface of the substrate around the big through hole,
a conductive circuit formed in contact with the wire bonding part to conduct,
a small through hole formed through the conductive circuit and the substrate,
a pin which is inserted and fixed in the small through hole,
wherein at least the edge of the pin and wire bonding part are left, and others are covered with synthetic resin.
In this invention, paper, woven fabric which consists of fiberglass, the thing that impregnated a resin formation thing such as an epoxy and phenol, polyimide in the non-woven fabric and so on, the paper epoxy product layer board that a laminate molding was stiffened, paper phenol product layer board, glass epoxy product layer board, printed circuit board material such as glass polyimide product layer board, the thing that the resin formation thing which it was acceptable with was molded in the board-shaped as to the heat, what made it spread copper foil with the thing that the resin formation thing which it was acceptable with was molded in the board-shaped as to the heat are used as materials of the circuit board.

Though a limitation doesn't specially have it, it is desirable to use copper in the price, the point such as heat conduction as a material which forms a continuity circuit and wire bonding part. A limitation doesn't specially have it, and for example it is made to spread copper foil on the surface of the circuit board, and copper paste is printed, and it stiffens it, and a copper film is formed with a means such as plating management, and etching is done corresponding to the necessity after that, and formed in the form of hope as for the way as well that a continuity circuit and wire bonding part form it.

It is desirable that a clearance with the big penetration hole and the semiconductor device is about 0.5mm though the size of a big penetration hole to set up in about the center of the wiring board is set up corresponding to the size of the semiconductor device.

The continuity circuit which does a wire bonding part and continuity faces the center of the pin, and it is desirable to exist in the concentric circles-shaped, and the circumference of a small penetration hole to set up around the big penetration hole fixed a pin and a continuity circuit under the condition that it connects electrically in this concentric circles-shaped part (land part). Fix by brazing filler metal are put on, and a means such as fix by conductive adhesive fixed under the condition that it connects electrically on the head of the pin and the land part if for example the form of the pin presents the head-shaped of the nail and the diameter of the straight line part of the pin is smaller than a diameter in the small penetration hole and then the diameter of the head of the pin is bigger than the outside diameter of the small penetration hole and it is the dimension of the outside diameter and under of the land part.

Though a limitation doesn't have it, the quality of the material of the pin can specially use covar, a Ni alloy such as 42 alloy and 52 alloy, copper, a copper base alloy, and so on. It is desirable to use a longer thing than a circuit board, and a certain thing is desirable by more than 1mm as for the projection length to make the length of the pin project more than a circuit board to insert and which fixed.

Fixing with this pin and the circuit board is desirable because it is excellent in the adhesion strength if it fixed a part with the continuity circuit formed in the head of the pin and the circuit board in the solder, the silver solder, and so on though the resin and so on which it is acceptable with is used for the solder, the silver solder, the heat hardening resin and the heat-resistant heat.

It doesn't matter even if synthetic resin for covering is a heat hardening plastic or it is a thermal plasticity resin. For example the resin which it is acceptable with, and that hardening medicine are chosen as to epoxy resin, polyimide resin and the silicone as to a heat hardening resin such as a strange sex epoxy resin and that hardening medicine or the heat such as a saturation polyester resin and polyimide resin in the use and the terms of use, and it uses.

It meets necessity, and dissolution quartz powder, alumina powder, boron nitride powder, a reinforcement material such as a mineral filling up material such as aluminum nitride powder and fiberglass, and so on are added in the synthetic resin by this invention. It is desirable because the heat conductive rate of the

wiring board for semiconductor element loading which it can get if the above mineral filling up material is added in the synthetic resin rises and excellent in the radiation.

Though synthetic resin for covering can cover the whole surface in continuity circuit, it is desirable to cover it except for the part which is next to wire bonding part so that a hindrance may not arise for the work and the union of the wire to wire bonding part. A wall in the big penetration hole meets necessity again, and it is decided that it covers it.

Because the tip of the pin and wire bonding part are at least left and other parts are covered with synthetic resin, as for this invention, it is possible that a semiconductor element loading part inside the big penetration hole is made cavity structure. The process which these both are connected to through the leading wire (wire) becomes easier, and the depth of cavity is desirable if the height with the surface and wire bonding part of the semiconductor element almost takes the depth which is the same when a semiconductor element is carried on the semiconductor element loading part though it isn't specially restricted.

[Execution example]

Example 1

It was made to spread copper foil of the thickness 35 μm on a dimension 30× 30mm in the single side of the glass un-woven fabric composite product layer board (manufactured by Shin-Kobe electronics, trade name CEM-3) of the thickness 0.6mm, and it was just, and 72 small penetration holes 1 of a diameter 0.55mm were set up in the carbide drill in the interval as shown in the part except for that center (dimension 8× 8mm) in the 1st figure 2.54mm. A resist film was formed in the surface after this, and it had etching, and the exfoliation of a resist film was done and got the circuit board 5 which formed wire bonding part outside end part 4 in the position of 2.5mm from the end in the center of the previous item more in the surface in the position of 1mm from the fixed continuity circuit 2, the end in the center of the previous item wire bonding part inside end part 3.

Next, the center of the above circuit board 5 was pierced with a mold in the dimension of 8× 8mm, and the big penetration hole 6 shown in the 2nd figure was formed. And, in the chance small penetration hole 1 the inside, diameter, one end part is processed into the head-shaped of the nail by 0.50mm, the thickness of the head top part is 0.2mm, the diameter of the head top part, 0.8mm, length, the nail head pin 7 of 52 alloy of 7mm was inserted, and it exposed one other end part (terminal) in the bottom, Sn : It fixed a nail head pin 7 by the solder of Pb = 63:37, and sealed airtight a small penetration hole 1 the inside. A part except for a tip 5mm of the nail head pin 7 and wire bonding part (from wire bonding part inside end part 3, the part of wire bonding part outside end part 4) and the wall in the big penetration hole 6 was covered by epoxy resin formation thing 9 after this, and it got the wiring board for semiconductor element loading which had a semiconductor element loading part 8 at the bottom of the big penetration hole 6.

An epoxy resin formation thing is the thing which dissolves 2 ethyl 4 methylimidazole part 0.15 weight as acid uncertain matter-less hardening medicine

in methyltetrahydro water-less phthalic acid (manufactured by Hitachi Chemical Co., Ltd, trade name HN-2200) 60 weight part and which mixed, hydrogenated Bis Phenol A pattern epoxy resin (manufactured by the Asahi electrification, trade name EP-4080), epoxy our quantity 235 - 255, average epoxy our quantity part 245)30 weight, manufactured by Bis Phenol A pattern epoxy resin (shell chemistry, trade name epicoat 834, The thing 50 weight part to dissolve epoxy our quantity 225 - 280 and average epoxy our quantity part 250)70 weight and which mixed, the thing which boron nitride powder (GP manufactured by Denki Kagaku Kogyo K.K.) 50 weight part was mixed with well are used, They are poured in the mold which heated in 130℃, and is lukewarm to 170℃ in 5 minutes the gold pattern bottom part. It stiffened it from the bottom part made of the money, and stiffened it in about 15 minutes. After that, hardening was done in 150℃ for 1 hour.

On the other hand, a dimension got the mother chip that thickness formed a requested wiring pattern by 6.5 × 6.5mm in the single side of the silicone crystal of 0.3mm. Next, a dimension carries the semiconductor element 11 of 3× 4mm on the 3rd figure in this mother chip 10, both, Sn of the diameter 120μm and the height 100 μm : It connected with a solder pillar of Pb= 5:95, and got a compound semiconductor element.

A silicone rubber formation thing 13 was used in the semiconductor element loading city 8, and a compound semiconductor element was glued after this. A silicone rubber formation thing 13 used the thing that the above boron nitride powdered 50 weight part was mixed with the silicone rubber (manufactured by Shin-Etsu Chemical Co.,Ltd., trade name KE45W) 50 weight part well. And, a silicone rubber formation thing 13 was computed so that thickness might be 0.05mm, and supplied to the semiconductor element loading part 8, and it glued a compound semiconductor element.

The cap 15 which an outside diameter dimension shows in the 4th figure that the part of the width 5mm of the circumference part formed the concavity of the depth 2mm in the height 3mm by 30× 30mm in the part in the center 20× 20mm after this is molded by using the epoxy resin formation thing a previous item and made.

The mother chip 10 and the space of the above wire bonding end part were connected with the supersonic waves by using aluminum wire 14 that a diameter contained the silicon of 50μm in 1 weight percent. The circumference part of the cap 15 was fitted to the part of the circumference at the surface of the wiring board for semiconductor element loading, and it faced the same epoxy resin formation thing 100 weight part with the previous item, and wiring board for semiconductor element loading which carried a cap 15 and a compound semiconductor element by using epoxy resin adhesive 12 that 2 weight part added 2 ethyl 4 methylimidazole was glued and got a semiconductor device.

And, it was calculated to be thickness 0.4mm, and the amount of computation was applied to become equal in the circumference part of the cap 15 almost, and it stiffened epoxy resin adhesive 12 in 150℃ and 10 minutes.

A pin was ruptured by the f/ piece 9.2kg by pulling out, and a pin couldn't be measured by the depression as to buckle when the pulling out (pulling in the pin tip direction) strength of the pin and the depression (depression in the head-

shaped direction of the nail) strength of the pin were measured about the semiconductor device which it could get.

When permittivity and a heat conductive rate were measured again, permittivity was about the same as glass epoxy wiring board, and a heat conductive rate from the bottom of the mother chip 10 to the bottom of the semiconductor element loading part 8 was compared with 0.001Cal/ cm · second · ℃ of glass epoxy product layer board in 0.0024cal/ cm · second · ℃, and it was about 25 times with 5.3.

The corrosion of aluminum wire wasn't seen though the semiconductor device which sealed airtight was examined with a pressure cooker testing machine with the 2 atmospheric pressure (gauge pressure), the condition for 100 hours at 121℃.

A lever was operated, and a nail head pin 7 was put in the socket and fixed after 72 nail head pins 7 exposed from the wiring board for semiconductor element loading again were inserted into the socket (It isn't illustrated.) for the load-less insertion.

A rupture such as a crack didn't occur in the solder pillar which a mother chip 10 and a semiconductor device 11 were connected with though the operation to put this nail head pin 7 was repeated 100 times though distortion occurred in the nail head pin 7 when a nail head pin 7 was put.

Example 2

It got a wiring board for semiconductor element loading and a semiconductor device by the same method as the execution example 1 and the process except that polyamide-imide resin formation thing was used instead of epoxy resin formation thing used with an execution example 1. Molding was made the method that a mold was refrigerated with warm water of 60℃ in the mold that the resin formation thing heated in 260℃ as a result that polyamide-imide resin formation thing which is the resin which it is acceptable with instead of epoxy resin formation thing which is heat hardening as to the heat was used was heated in 260℃ in the rest with the pressure at once.

And, a resin formation thing used the thing that the thing used for the polyamide imide resin (own combination goods) 50 weight part with an example 1, and same boron nitride powdered 50 weight part were mixed with the uniformity.

When pull and depression strength of the nail head pin were measured about the semiconductor device which it could get, a nail head pin was ruptured by the 8.3kg f/ piece by pulling out, and a nail head pin couldn't be measured by the depression as to buckle.

Though the operation to put a nail head pin in the same method as the example 1 again was repeated 100 times, a rupture such as a crack didn't occur in the solder pillar which a mother chip and a semiconductor device were connected with.

Comparative example 1

It was made to spread copper foil of the thickness 35μm on an outside diameter dimension 30× 30mm on both sides of the glass un-woven fabric composit product layer board (manufactured by Shin-Kobe electronics, trade name CEM-3) of the thickness 1mm, and it was just, and 72 small penetration holes 1 of a diameter 0.55mm were set up in the carbide drill in the interval as shown in the part

except for that center (dimension 8× 8mm) in the 5th figure 2.54mm. A resist film was formed in the surface after this, and it had etching, and the exfoliation of a resist film was done and got the circuit board 5 which formed wire bonding part outside end part 4 in the position of 2.5mm from the end in the center of the previous item more in the surface in the position of 1mm from the fixed continuity circuit 2 and the end in the center of the previous item wire bonding part inside end part 3.

The thickness of the head top part was 0.2mm, and it was processed into the head-shaped of the nail of 0.8mm, and a part under 0.5mm from the head of the nail was crushed so that maximum width might be 0.65mm with a mold, and a nail head pin 17 made of 52 alloy of the length 7mm that convex 16 was formed in the middle was inserted, and made to engage with the small penetration hole in the part of convex 16, and the diameter of the head top part got the wiring board for semiconductor element loading which showed it in the 5th figure in the chance small penetration hole 1 the inside by 0.5mm the diameter one end part. Next, the compound semiconductor element which it got with an example 1 in the center of this wiring board for semiconductor element loading was glued in the same method as the example 1.

When pulling out of the nail head pin and depression strength were measured in the same method as the example 1 after this, a nail head pin was ruptured by the 8.3kg f/ piece by pulling out, and the nail head pin of 1.7～2.8kg f/piece came out from the circuit board by the depression.

When the operation to put a nail head pin in the same method as the example 1 was repeated, it was only repeated five times, and a crack appeared in the solder pillar which a mother chip and a semiconductor device were connected with, and an electrical continuity couldn't be secured.

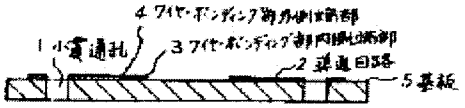
And, the work to connect a cap with the part of the circumference of heat exchanger plate wasn't done because a fault arose before connecting a cap with a comparative example 1.

[Effect of the invention]

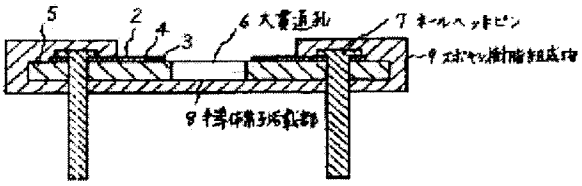
The wiring board for semiconductor element loading of this invention is excellent in the mechanical strength without occurrence of the curve, and it is not in the problem at all in the adhesion in case of airtight sealing.

[Brief explanation of the drawing]

As for the first figure and the second figure, the cross section which shows a state of manufacture work of the wiring board for semiconductor element loading in the example of this invention in section, and the third figure and the fourth figure are the cross sections which show a state of manufacture work of the semiconductor device which a wiring board for semiconductor element loading was used for in section.



第 1 図



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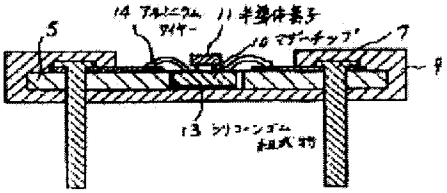

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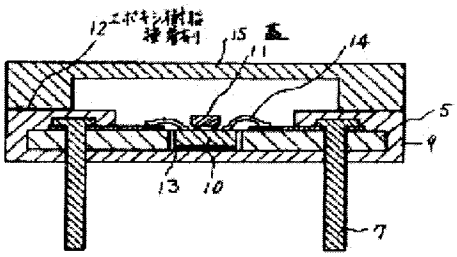

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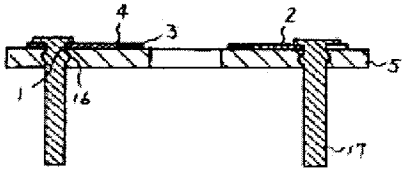

第 5 図